THE LAKE OPEONGO CREEL SURVEY

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THE LAKE OPEONGO CREEL SURVEY

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NO. 19

M.J. McMURTRY and B.J. SHUTER

Ontario Ministry of Natural Resources
Research Section, Fisheries Branch
Maple, Ontario L0J 1E0

C.H. Olver, Editor

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ABSTRACT

McMurtry, M. J., and B. J. Shuter. 1985. The Lake Opeongo creel survey. Ont. Fish. Tech. Rep. Ser. No. 19: iii & 16 p.

A creel survey has been conducted at Lake Opeongo from 1936 to the present. Changes in creel survey methods and in angler characteristics have occurred over this period. The two most significant changes have been a decrease in the number of guided parties and an increase in the amount of camping on undeveloped sites around the lake. The effects of these and other changes on angler efficiency and survey coverage are discussed. In general, coverage of the total catch by the creel survey appears to have declined since the mid-1950s. An improved weekday survey during the 1970s partially countered this decline. A synopsis is provided of the problems involved in using creel survey data to estimate relative abundance, total catch, total fishing effort, and to represent biological characteristics of the population at large, such as size and age structure.

Keywords: Algonquin Park, Lake Opeongo, creel survey, lake trout, smallmouth bass.

THE LAKE OPEONGO CREEL SURVEY

INTRODUCTION

A creel survey has been conducted at Lake Opeongo in Algonquin Park, Ontario, for almost half a century. It is, to our knowledge, the longest standing uninterrupted source of data on moderately exploited freshwater fish populations extant. Over the period of the survey, there have been significant changes in the behaviour and efficiency of anglers and in survey procedures, which must be considered in the interpretation of survey data. There has been some documentation of these changes (e.g. Fry and Kennedy 1937; Martin and Fry 1973), but until recently, a great deal of information existed only in the memories of those who have been, or are now, closely associated with the survey. The purpose of this report is to consolidate information on these changes, and to explain how they affect the use of creel survey data to describe fish population size and structure.

Interviews were conducted in the spring of 1983 with those experienced in the survey: F.E.J. Fry, N.V. Martin, R.J. Murdock, J.M. Fraser, D. Cucin and J.A. MacLean. Complete transcriptions of these interviews are available at the Ontario Ministry of Natural Resources (OMNR) Research Library, Box 50, Maple, Ontario. Where possible, we have described changes in quantitative as well as qualitative terms, and indicated the specific year(s) when changes occurred. We have also attempted to identify those areas in which there is consensus or disagreement amongst the sources.

THE CREEL SURVEY METHOD AT LAKE OPEONGO

The fish populations of Lake Opeongo (Fig. 1) first became subject to serious exploitation in 1936, with the construction of a new highway through Algonquin Park (Martin and Fry 1973). A creel survey at Lake Opeongo was initiated at the same time by W.J.K. Harkness who asked F.E.J. Fry to take charge of it (F.E.J. Fry, pers. comm.[1]). This work was part of the program of the Ontario Fisheries Research Laboratory, University of Toronto. Lake Opeongo was well suited to the creel survey because, at this time, there were very few sites of organized human activity on the lake, and the only point of vehicular access was at the foot of the South Arm in Sproule Bay (Fig. 1). An outfitting establishment was built at Sproule Bay by Joseph Avery in 1936 which provided accommodations, supplies, guides, and boats to anglers. A single private cottage, located on an island at the mouth of Sproule Bay, was occupied for about 6 months of each year from 1930 to the early 1970s. A ranger cabin on Sproule Bay was also used in the 1930s and 1940s. The only other sites of human activity were a few undeveloped campsites spread around the lake (Martin and Fry 1973). This is still the case in 1983, although the number of undeveloped campsites has increased. In the following paragraphs, we outline the creel survey procedure as it was at the beginning of the study in 1936, and then record changes in procedure, in chronological order.

In 1936, one of Avery's cottages was rented and served as the headquarters of the research laboratory at Lake Opeongo (Fig. 1). The creel survey was first conducted from a tent erected near the dock on Sproule Bay (F.E.J. Fry, pers. comm.). The most complete published description of the survey method is found in Fry and Kennedy (1937).

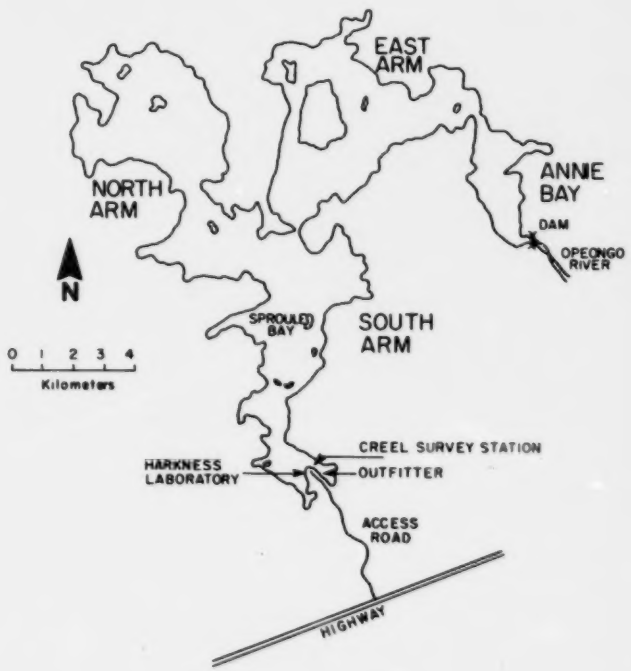

Figure 1. Map of Lake Opeongo showing access point, creel survey station, outfitter's site and Harkness Laboratory.

[1]All personal communication citations refer to interviews conducted in 1983.

Forms (Fig. 2) were issued to anglers at Lake Opeongo by Park officers and members of the laboratory, and were also available at two measuring stations. The measuring stations consisted of a sign with instructions, a measuring board, a supply of forms, and a pencil. Information collected on the forms included the date, number of each fish species caught, the length of each fish to the nearest inch (an estimate of the average size of the fish taken was made for about one-third of the lake trout caught), the number of hours spent fishing, the depth fished, and the lure and method used. The aim of the survey was "a reliable measurement of the size composition of the catch and an estimate of the fishing effort" (Fry and Kennedy 1937).

When interviewed, Fry supplied further details of the first few years of the survey. An effort was made to have a member of the laboratory fill out the survey form whenever possible. Parties which had not caught any fish were interviewed, and the effort they exerted was recorded. Fry estimates that 95% of the survey data were collected in this way in the early years; the measuring stations were not used often, and Park officers played a less important role in the Lake Opeongo survey than they did in the survey of other Algonquin Park lakes. One person carried out the survey at Lake Opeongo at this time. The survey worker had some other responsibilities - for example, he (all early survey workers were male) was to help establish a Park-wide creel survey through the cooperation of Park rangers and resort owners - but his main responsibility was to ensure that there was a complete creel survey at Lake Opeongo.

No formal schedule was kept by the survey worker. He lived at Sproule Bay and interviewed every angler he could. There were two sources of information: (1) the guides who operated out of Avery's lodge and who would bring in the fish caught by their clients; and (2) unguided anglers. The fact that the survey worker cleaned all the fish he examined provided an incentive for parties previously acquainted with the survey to bring their catch to him. Guides were particularly eager to have their parties' catches cleaned.

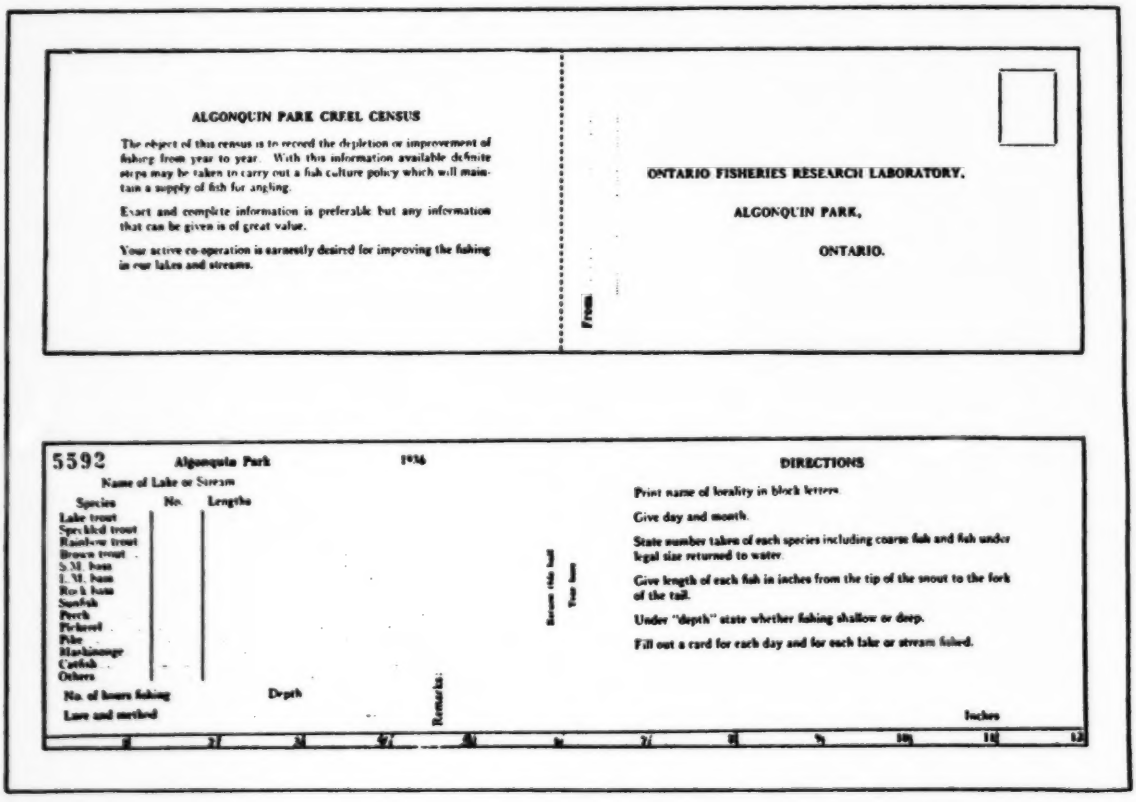
ALGONQUIN PARK CREEL CENSUS
The object of this census is to record the depletion or improvement of fishing from year to year. With this information available definite steps may be taken to carry out a fish culture policy which will maintain a supply of fish for angling.
Exact and complete information is preferable but any information that can be given is of great value.
Your active co-operation is earnestly desired for improving the fishing in our lakes and streams.
From
ONTARIO FISHERIES RESEARCH LABORATORY,
ALGONQUIN PARK,
ONTARIO.
5592
Algonquin Park
1936
Name of Lake or Stream
Species
No.
Lengths
Lake trout
Speckled trout
Rainbow trout
Brown trout
S. M. bass
L. M. bass
Rock bass
Sunfish
Perch
Pickerel
Pike
Muskinonge
Catfish
Others
No. of hours fishing
Depth
Lure and method
Remarks
Brown trout
True bass
DIRECTIONS
Print name of locality in block letters.
Give day and month.
State number taken of each species including coarse fish and fish under legal size returned to water.
Give length of each fish in inches from the tip of the snout to the fork of the tail.
Under "depth" state whether fishing shallow or deep.
Fill out a card for each day and for each lake or stream fished.
Inches

Figure 2. Creel survey form used at Lake Opeongo in 1936 (from Fry and Kennedy 1937).

The survey station at Sproule Bay was usually occupied in the morning when the anglers went up the lake, and in the evening when they returned. There was no difference between the survey worker's activities on weekdays and on weekends. Avery himself did not play an important role in notifying the laboratory when anglers came in; the survey worker was simply to be at the dock to meet the boats as they arrived (F.E.J. Fry, pers. comm.). The survey started at the beginning of May in 1936 and ended in late October (Fry 1936; Fry and Kennedy 1937). In succeeding years, the survey was started immediately after ice break-up. The best available estimate for the average date of ice break-up in Lake Opeongo is May 1 (based on unpublished data of D. Cucin for the period 1964 to 1982).[1] Normal survey procedures usually ended with the September Labour Day holiday, but there was often a reduced fishing effort and a correspondingly reduced effort put into the survey for several weeks following this (based on examination of creel survey records and discussions with D. Cucin).

By 1939, the creel survey form had been modified to include information on the number of people fishing and the number of boats. With a change in senior personnel in 1941 (see Table 1), a detailed description of the survey procedure was printed in order to provide instructions for workers who would not have the opportunity to learn by working with someone already familiar with the procedure (Kennedy 1941). Little had changed since 1936. The instructions emphasized that, of the Algonquin Park lakes, Lake Opeongo should be given priority in the creel survey and that there should be at least one full-time worker at Lake Opeongo. Activities associated with creel surveys of other lakes were encouraged, but only if they did not interfere with getting complete data on Lake Opeongo. The worker was to make several trips around the lake in July and August to interview people camping there. He was to do egg counts on a sample of lake trout, collect scale samples and, if convenient, collect data on stomach contents. Also, the collector was instructed to personally record the data on the survey forms. The information collected was the same as in 1939, except that the collector was to also note if the anglers fished from shore. The survey worker was encouraged to be friendly and courteous to the fishermen, and to freely discuss the survey and the fishery in general. Further specific instructions were given for examining stomach contents, taking egg samples and counting eggs.

A full-time survey worker was maintained at Lake Opeongo throughout the war years, despite a decrease in fishing activity (see Table 1 for names).

[1]Since 1968, the survey has been started after ice break-up or at the start of the lake trout season, whichever comes last.

Table 1. Persons responsible for Lake Opeongo creel census.

Year	Person responsible
1936-1940	F.E.J. Fry[a,b]
1941	W.A. Kennedy[b] (H.M. Tovell collected data)
1942, 1943	D. Kirk[a]
1944	J.A. Long[a]
1945	R. Tasker[a]
1946-1949	N.V. Martin[a,b]
1950	N.S. Baldwin[a]
1951-1963	N.V. Martin[a,b]
1964-1969	J.M. Fraser[b]
1970-1981	D. Cucin[a,b]
1982,1983	J.A. MacLean[a]

[a]Collected data.
[b]Supervised data collection.

By the time N.V. Martin took charge of the survey in 1946, the survey worker was being assisted by additional Avery staff, who notified him when fishing parties arrived at the dock at times when the survey station was not occupied (N.V. Martin, pers. comm.). The survey worker was usually alerted only when the party had fish to examine (R.J. Murdock, pers. comm.), but it would not matter what the catch was: lake trout (*Salvelinus namaycush*), smallmouth bass (*Micropterus dolomieui*), or fish from another lake (N.V. Martin, pers. comm.). The guides working out of Avery's camp would regularly call over to the laboratory both during the week and on weekends, to have their catch cleaned and examined (N.V. Martin, pers. comm.).

During Martin's tenure at Lake Opeongo, there was a worker at the survey station every evening, roughly from 5 pm to 8 pm, as most fishermen returned from the lake at this time (N.V. Martin; R.J. Murdock, pers. comm.). Martin did the survey himself in the first few years, but later a student was hired to do it. The practice of hiring students has continued to the present. No formal schedule was kept - there was no stratification of hours - the survey worker was expected to meet every boat that came down the lake. During the day, the student would be nearby, but not usually at the survey station. He would go over to the station if he saw a boat coming in or if notified by one of Avery's staff. The pattern on weekends did not differ greatly from that on weekdays, however, the survey station was usually manned on Sunday afternoons and evenings when most fishermen departed from the lake (N.V. Martin, pers. comm.). In 1946, the survey station consisted of an outdoor table near Avery's lodge; this was replaced in 1949 with a small wooden building further to the west (N.V. Martin, pers. comm.; Martin 1968).

Until the mid-1950s, creel survey data were stored only on the original survey forms. They were, therefore, vulnerable to being destroyed or lost (forms for some years - 1938 for lake trout, 1936 and 1946 for smallmouth bass - were actually lost) and presented a storage space problem. At this time, the Lake Opeongo data were transcribed onto catch record sheets which were then duplicated. A large proportion of the original survey forms was then destroyed.

Two changes in the Lake Opeongo fishery became a concern in the last half of the 1950s; namely, a steady increase in the number of anglers camping on the lake, and a decrease in the number of guided parties. In response to the latter change, a record of the relative success (catch-per-unit-effort) of guided and non-guided parties was started in 1957 (N.V. Martin, pers. comm.). Casual surveys of camping anglers were probably carried out since the beginning of the creel survey at Lake Opeongo, but more effort was put into these in the late 1950s (N.V. Martin; R.J. Murdock, pers. comm.). A student was given a map of the campsites and he would take a boat around the lake and interview the parties camped there. A thorough campsite survey was conducted in 1962 (Martin 1962), to determine the value of campsite checks that had been made in previous years. The campsite checks were discontinued after considering the volume of time and effort involved and the small amount of data acquired.

J.M. Fraser assumed responsibility for the Lake Opeongo creel survey from 1964 to 1969, inclusive. He put two people to work at the creel survey hut on Saturdays, Sundays and holidays from 1 pm until dark (8-9 pm), because these were the days when most angling took place. During the rest of the week, the survey depended almost entirely on anglers calling over on their own initiative, and on the outfitter informing the laboratory when angling parties arrived at the dock. The survey hut was not occupied during the week unless a member of the laboratory was called over. The Avery family still ran the outfitting business at Lake Opeongo at this time, although Joseph Avery had died in May 1955. The Ontario government had taken over ownership and tendered the facility in 1960.

During the period when Fraser was in charge of the program, survey workers were instructed to ask all parties returning from the lake if they had fished. If so, a form was filled out for that party even if the party had caught no fish. If anglers brought in very large catches, the survey workers might occasionally record the total catch and examine only a manageable portion of it. The survey workers were supervised casually during the weekend.

D. Cucin took over responsibility for the creel survey in 1970. Until this time, the survey procedure established by Fraser was continued. In 1970 or 1971, Cucin increased survey coverage, particularly during the week, because of his concern over seeing younger and smaller fish in the catch sampled (D. Cucin; J.A. MacLean, pers. comm.). A record of the times when the survey hut was occupied has been kept periodically since 1971. During the 1970s, weekends and holidays were covered from about 10 am until 8 or 9 pm. On weekdays, students were stationed at the hut in the afternoon from 5 to 7 pm and/or in the evening after supper. Weekday coverage was increased in the mid to late summer, when the majority of people were in the Park on their holidays (D. Cucin, pers. comm.). From 1971 to 1973, when records of time spent in the survey hut are relatively complete, there was a person stationed in the hut roughly from noon until about 6 pm every weekday in July and August. In 1974 and later, the weekday schedule was more variable (J.A. MacLean, pers. comm.). If laboratory staff had time, they would go down to the survey hut. If they were doing some routine work such as egg counts, they would do this at the hut and still be able to contact fishermen as they left the lake.

Since J.A. MacLean took over responsibility for the survey in 1980, there has been a renewed attempt to increase coverage, particularly on weekday evenings. The survey workers are closely supervised on weekends (J.A. MacLean, pers. comm.). An example of the data sheet used in recent years is given in Fig. 3.

A new operator took over the outfitting concession in the mid-1970s. Fraser (pers. comm.) believes that the present operator is less active in notifying the laboratory about returning anglers than were the Averys. However, signs are now posted requesting that fishermen phone the laboratory or contact it through the outfitting store at times when the survey hut is unoccupied.

CHARACTERISTICS OF LAKE OPEONGO ANGLERS

As indicated in the previous section, the fish populations of Lake Opeongo first became subject to serious exploitation in 1936 when a highway to Algonquin Park was completed. The lake had been fished commercially by at least one operator during the First World War, and by an increasing number of anglers between 1918 and 1936, but the level of exploitation was probably relatively small due to the difficulty of access (Martin and Fry 1973). For the purposes of the following discussion therefore, the Lake Opeongo fishery is considered to begin with the 1936 season. In this section, we will first describe the pattern of angling found during the pre-Second World War phase of the fishery. Following this, the effect of the war on angling will be considered. Finally, general changes in angler characteristics which developed during the post-war period will be discussed.

CREEL CENSUS RECORD SHEET

LAKE _____ DATE _____

LOCATION _____ ANGLING METHOD _____

NO. of BOATS _____ BAIT _____

CATCH record number _ _ _ _

ANGLING					SPECIES	NUMBER KEPT	Number released	Number examined
MEN	x	HOURS	=	MAN HOURS				
	x		=		S. M. BASS			
	x		=		LAKE TROUT			
	x		=		BROOK TROUT (speckled)			
	x		=		SPLAKE			
	x		=					

SAMPLE

	Species	number	length	weight	age	sex	Stomach Contents	Remarks
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

RECORDED BY: _____

MALE		FEMALE
1	IMMATURE	7
2	MATURING	8
3	MATURE	9
4	RIPE	10
5	INFERTILE	11
6	SPENT	12

Figure 3. Creel survey data sheet used at Lake Opeongo in 1982.

In the early years of the Lake Opeongo fishery, angling effort was directed almost exclusively to lake trout. Smallmouth bass were probably not yet abundant. They had been in Lake Opeongo only about 8 years in 1936, and "presumably only 3 or 4 year classes had resulted since their arrival" (Martin and Fry 1973). In addition, they were not as highly prized as lake trout. Anglers would either stay at Joseph Avery's outfitting camp at Sproule Bay for a week or two, or come to the lake just for the day (F.E.J. Fry, pers. comm.). Most were from the United States or from nearby communities such as Whitney, Bancroft, Huntsville and Peterborough. Many parties would hire one of the guides that worked out of the outfitting camp to take them fishing.

The guides were highly skilled fishermen and their clients were usually successful in catching lake trout (N.V. Martin, pers. comm.). The few anglers that did not hire a guide were generally local people who were also skilled fishermen. Some parties would camp on the lake for several days, especially in July and August (Fry and Kennedy 1937), but the numbers involved in camping were much smaller than the numbers observed in later years, particularly the 1960s and 1970s. Camping parties would eat most of their catch except perhaps for fish caught on the last day, as they were not equipped to hold fish on ice (F.E.J. Fry, pers. comm.). We found no information on the species caught by campers at this time, but in later years campers caught and ate mainly smallmouth bass. Analysis of the creel survey data showed that, in all years, smallmouth bass parties fall into two distinct groups: those which ate their entire catch before being interviewed, and those which had their entire catch in their possession when interviewed. Assuming that the former group is made up largely of campers, these results suggest that even in the early years campers were eating much of their bass catch. The general opinion of creel survey staff is that a much smaller proportion of the total lake trout catch was eaten by anglers before they were interviewed. Lake trout were considered 'trophy' animals and were generally taken home.

The usual method of fishing for lake trout was to deep-troll two metal lines (often from a canoe at this time) each with an "otter-tail" (a type of spoon) attached (F.E.J. Fry; N.V. Martin; R.J. Murdock, pers. comm.). The lure was frequently baited with a cisco (*Coregonus artedii*), lake whitefish (*Coregonus clupeaformis*) or sucker (*Catostomus* spp.). A number of anglers, particularly the more experienced ones, still-fished for lake trout in the early years and were very successful (N.V. Martin, pers. comm.).

The only fishing regulations at this time were season restrictions and possession limits for lake trout and smallmouth bass, and a minimum size limit for smallmouth bass. A complete description of the angling regulations on Lake Opeongo, for the period 1936 to 1981, is given in Appendix A. Ice fishing was not common (even though no regulation prevented it until 1955) because access to the lake in winter was difficult. In general, there were no flagrant violations of the rules. Occasionally, anglers would eat some fish and then bring in their limit (F.E.J. Fry, pers. comm.).

The number of fishermen at Lake Opeongo was reduced during the Second World War, due to restrictions of leisure time and limits on automobile travel set by gasoline rationing. Lake Opeongo was not then, and still is not, accessible by rail (Harkness 1942). As individuals were unable to obtain much private gas for boats during the war years, fishing was conducted almost entirely through Avery's lodge (Kirk 1943). Both of these factors allowed survey workers to keep track of anglers more easily. V.E. and V.J. days both occurred during the 1945 angling season, and brought an end to the wartime lull in fishing intensity (Tasker 1945).

After the war, the two most important changes to occur in the character of Lake Opeongo anglers were: (1) a reduction in the number of guided parties, and (2) an increase in the number of anglers camping on the lake. These interrelated changes occurred gradually, but first became a concern in the last half of the 1950s (N.V. Martin, pers. comm.). Starting in 1957, a record of the relative success of guided and non-guided parties was kept through the creel survey. Values for 5 successive years are shown in Table 2. The catch-per-unit-effort is roughly 50% greater for guided parties than for non-guided parties. Thus, a reduction in the proportion of guided parties would produce a decrease in overall angler efficiency, unless there was a compensating increase in the efficiency of non-guided parties. The number of skilled local anglers has gradually increased, but probably not enough to compensate for the decrease in guided parties.

Table 2. Catch-per-unit-effort (CUE) for guided and non-guided parties at Lake Opeongo. CUE = number of lake trout caught per 100 h fishing by 2 men (200 man-h); effort exerted by parties with no catch included in effort figures (data obtained from N.V. Martin).

	Catch-per-unit-effort	
Year	Guided parties	Non-guided parties
1957	68	44
1958	45	31
1959	39	25
1960	38	17
1961	42	30

In the last few years, the proportion of novice anglers has grown rapidly (D. Cucin; J.A. MacLean, pers. comm.). Novices include those who have some angling experience but do not know

Lake Opeongo, and those who know neither how nor where to fish. Both groups have some success fishing for bass and some success fishing for lake trout in the spring, but the latter group has virtually no success fishing for lake trout in the summer (J.A. MacLean, pers. comm.).

Until the mid-1950s, 10 or more guides were constantly employed on Lake Opeongo (Martin and Fry 1973). Strangers to the area would almost certainly have a guide. Many Americans fished Lake Opeongo at that time. They would come back year after year, would get to know the local residents, and would specify the guide they wanted for their one- or two-week vacation (R.J. Murdock, pers. comm.). When Fraser began work on Lake Opeongo in 1961, there was still a significant number of guided parties. He estimates that 25% of the parties were guided. At this time, the guided parties were fishing mainly for lake trout, but would fish for bass for diversion. The guide would know of spots which might yield large bass. By the early 1970s, only one or two guides were available, and their services were not in great demand (Martin and Fry 1973).

Several factors may have contributed to the decline in guiding. First, fishermen who returned to the lake year after year gradually gained expertise and were able to fish successfully without a guide. Second, accommodations for guides and fishing parties at the outfitters lodge were discontinued in 1960 when the Ontario government took over ownership of the facilities (Martin 1968). Camping by anglers on undeveloped sites around the lake increased rapidly after this. Third, groups started coming to the lake to spend a holiday in which fishing was not the primary activity (J.M. Fraser, pers. comm.). These groups, often families, would go out boating for the day or camp on the lake and spend only a small portion of their time fishing - perhaps only the children would fish (N.V. Martin, pers. comm.). Such casual anglers would usually fish for smallmouth bass, because they lacked the knowledge and specialized gear required for lake trout fishing. Bass fishing could be done almost as effectively from shore as from a boat, using spinning gear. The interest in bass and the effort exerted to catch them certainly increased (N.V. Martin, pers. comm.). At least part of this increase may have been a result of a decline in the quality of the lake trout fishery.

Camping parties often consumed their entire catch at the campsite and therefore had no fish to be examined at the creel survey station (J.M. Fraser, pers. comm.). Many parties would dress their catch and store it on ice until their departure. Campers were not usually recognized as angling parties by the outfitters, who played an important role in notifying the survey workers of incoming anglers (J.M. Fraser, pers. comm.).

Two separate indices of the amount of camping on Lake Opeongo are shown in Figs. 4 and 5. In Fig. 4, the number of parties in which each individual spent at least 8 hours fishing during his/her stay at the lake, is expressed as a fraction of the total number of parties recorded in the survey. This fraction is assumed to be an approximate indicator of the relative amount of camping on the lake, as day-use anglers are likely to fish for a shorter period of time than 8 hours. There is an almost continuous increase in such parties from 1938 until 1959. A particularly rapid increase occurs throughout the 1950s. A peak occurs in the late 1950s to early 1960s; a decline follows this and then another rise to 1979. This pattern corresponds reasonably well with verbal accounts of the trend in camping on Lake Opeongo, especially with respect to the rapid rise through the 1950s (N.V. Martin, pers. comm.). However, both Fraser and Murdock (pers. comm.) believe that camping continued to increase through the 1960s; Fraser believes it reached a peak sometime in that decade. The apparent decline after 1963, seen on Fig. 4, could be attributed to the reduced efficiency of creel survey coverage of campers leaving the lake on weekdays. The survey hut was not occupied during weekdays, from 1964 to about 1970 (J.M. Fraser; D. Cucin pers. comm.), and the outfitters were not inclined to notify the survey workers of campers leaving the lake. Mid-week survey coverage (and therefore, coverage of campers) improved after 1972.

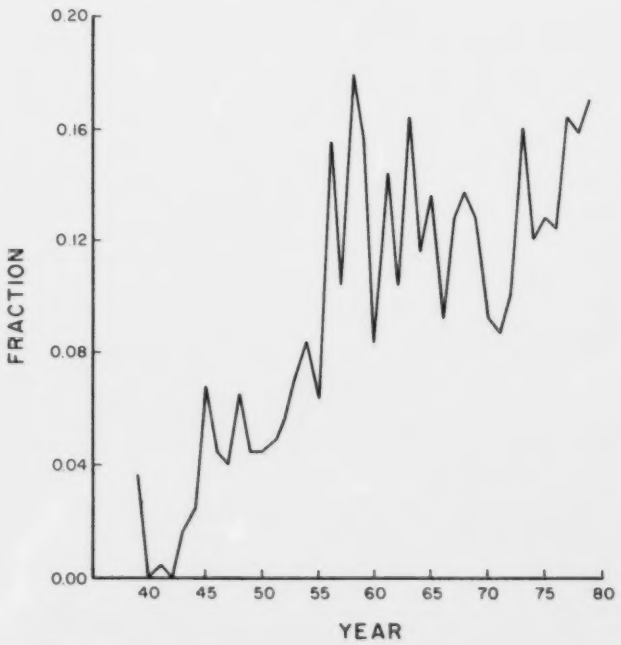

Figure 4. The number of creeled parties which fished for at least 8 h per person, expressed as a fraction of the total number of parties seen at the creel survey hut. This fraction is assumed to be an index of the relative amount of overnight camping on the lake.

Fig. 5 shows the number of campers per annum in the interior of all of Algonquin Park from 1958 to 1982. There is a dramatic increase from the late 1960s to about 1976, followed by a sharp decline. The period of the greatest increase in camping shown in this figure does not correspond with verbal accounts of camping trends at Lake Opeongo. It seems likely that camping increased earlier at Lake Opeongo than in the Park as a whole, and that the sites at Opeongo were quickly saturated. From 1978 to 1982, the number of campers using Lake Opeongo primitive campsites represented 12-14% of the total number of campers using interior campsites in Algonquin Park. Similar information is not available for the years prior to 1978. Cucin and Murdock (pers. comm.) believe that there has been a trend towards shorter camping holidays and more day angling on Lake Opeongo since the 1970s. People will stay in a nearby town or campground and only come to Lake Opeongo for the day. In early spring, however, ardent anglers still stay at Lake Opeongo for about a week at a time.

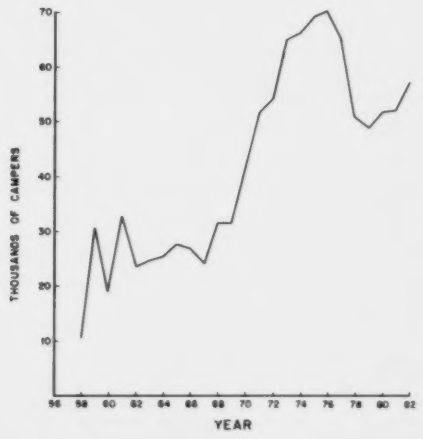

Figure 5. Number of campers in the Algonquin Park interior from 1958 to 1982. Data from Parks and Recreational Areas Branch, Ontario Ministry of Natural Resources.

To summarize, as guiding decreased and camping increased, the daily and seasonal patterns of fishing on the lake became increasingly erratic and unpredictable. As a result, there has almost certainly been some decline in the proportion of fishermen who are interviewed by creel survey staff.

Changes in gear have probably had a minor effect on lake trout angling efficiency over the duration of the creel survey. The Williams' Wabler replaced the "otter-tail" as the lure of choice, sometime in the late 1930s or 1940s. Also, early in the fishery, the motorboat began to replace the canoe as the usual means of trolling (N.V. Martin, pers. comm.). The depth sounder has become increasingly popular since the 1960s (D. Cucin; J.M. Fraser; R J. Murdock, pers. comm.). Previously, fishermen had to know the lake and where the fish were at different times during the summer, or had to observe the depth and location that successful anglers fished. Once depth sounders became available, fishermen could locate schools of cisco and assume that lake trout would be close by or, occasionally, could locate lake trout directly. Downriggers[1] have also been used in recent years with the disapproval of some anglers (D. Cucin; J.M. Fraser; R.J. Murdock, pers. comm.).

Anglers using these devices have had success on Lake Opeongo, but there is no consensus amongst those associated with the creel survey that the new methods are more successful than the traditional ones (D. Cucin; R.J. Murdock, pers. comm.). Since only a minority of anglers use depth sounders and downriggers - MacLean estimates that about 6 boats per season have come equipped with downriggers in the last few years - it is unlikely that this has had a marked effect on overall angler efficiency.

Two changes in gear may have had a minor effect on smallmouth bass angling efficiency: the replacement of bait casting gear by spinning gear, and the advent of monofilament line.

Changes in fishing regulations are described in Appendix A. Most significant of these are the banning of winter fishing in 1955, and the removal of a minimum size limit for smallmouth bass in 1956. The consensus amongst those interviewed is that violations of fishing regulations for smallmouth bass and lake trout have been minor; there is some pre-season bass fishing, and a few anglers exceed the daily catch limit for bass during the season. Since enforcement officers visit Lake Opeongo frequently, most anglers realize that there is a good chance that their catch will be examined, and therefore, do not exceed the limit. More importantly, few anglers catch close to their limit of lake trout (J.A. MacLean, pers. comm.).

Fishing derbies for lake trout have been held for many years on Lake Opeongo, sponsored variously by the maker of the Williams' Wabler, the Lake Opeongo outfitters, and local angling clubs. Most derbies lasted a day only and prizes were offered to anglers catching the smallest fish, the longest fish and the most fish, so that all fish caught would be entered. Since 1980, the Whitney angling club, rather

[1]A heavily weighted line which is clipped to the baited line and which holds it at a fixed depth for trolling. When a fish strikes, the baited line is released from the downrigger.

than having a day-long derby, has had a contest running the whole season in which a prize is offered at the end of the season to the angler catching the largest lake trout. Derbies have probably not had a significant effect on the overall catch according to Cucin, Fraser, Martin, and Murdock (pers. comm.).

EVALUATION OF CREEL SURVEY DATA

Creel survey data may be employed in several ways to describe fish populations. Catch per unit effort data are commonly used as an index of abundance. Absolute quantities such as total catch and total fishing effort may also be estimated, and the size and age of fish in the population may be described. For those segments of the population which are equally catchable, the relative size and age of the fish sampled in the survey are often assumed to be representative of the fish in the population. Size and age data may therefore be used to estimate growth rate. Total catch at age data may be used to estimate absolute abundance.

Different problems are associated with using creel survey data for each of the above purposes. In this section, we will first outline how the changes in survey procedures and angler characteristics, described earlier, affect the use of survey data for these purposes. We will then summarize when the major changes took place at Lake Opeongo, and discuss how some additional factors may affect the interpretation of creel survey data. Finally, we will present both optimistic and pessimistic views of the extent of Lake Opeongo creel survey coverage for use in setting bounds on estimates of total catch. Our objective is not to judge the merit of using survey data for specific purposes, but rather to indicate the problems that may be involved in doing so and thus permit others to make informed decisions.

The effects that changes in creel survey procedures and angler characteristics at Lake Opeongo have on estimating the quantities outlined above are shown in Tables 3 and 4. A brief explanation of the effect is included in the tables when necessary. The magnitude of each effect is uncertain, however the most important effects are marked with an asterisk.

In order to use creel survey data to estimate absolute quantities such as total catch and total effort, it is necessary that either the entire catch and effort be surveyed, or a known fraction (the "coverage") of the total catch and effort be surveyed. It is generally acknowledged amongst those who have worked at Lake Opeongo that the first condition does not hold there. As the percentage of the total catch covered by the survey is not known, it must be estimated. This has been done in two ways for Lake Opeongo: by simply "guessing" at it after accumulating experience with the survey, and by conducting mark-recapture experiments on fish caught on the lake and examined in the survey (see Regier 1971 for method).

If survey coverage is estimated accurately at frequent intervals (every year, for example), changes in survey procedure and angler characteristics can be accounted for in the estimates of total catch and effort. If unknown changes occur over time, then estimates of total catch and effort will be incorrect. Tables 3 and 4 describe some of the effects of coverage changes on quantities frequently estimated from creel survey data. If survey data are used only to provide indices of the absolute magnitudes of catch and effort, it is not necessary to estimate the actual level of coverage, but coverage must nevertheless be consistent from year to year.

Two independent tests show that fish sampled in the Lake Opeongo creel survey are generally representative of those kept by anglers. In 1969, Regier (1971) examined the length frequency distribution of lake trout marked while anglers remained on the lake and determined the percentage in each size class recovered at the creel survey station (Table 5). The percentage recovered in each size class was approximately equal. Our comparison (using unpublished data of Regier) of the length frequency distribution of smallmouth bass examined on the lake and at the creel survey hut during a two-week period in 1970 (Fig. 6) shows a tendency for fish of medium size to be underrepresented in the creel survey distribution. This effect is not particularly strong, and does not appear in the length distribution derived from all the survey data collected in 1970. Therefore, there seems to be no objection to using the biological characteristics (length, weight, age, etc.) of the fish sampled to represent those of all the fish kept by anglers.

The removal of the minimum size limit on smallmouth bass is the only change known to have significantly affected the extent to which the fish sampled can be considered representative of the fish in the population at large. Mean sizes of sampled fish aged 2 and 3 yr declined precipitously immediately after the limit was lifted in 1956 (Matuszek and Shuter, in preparation). This indicates that estimates of mean size at these ages, based on survey data, have a much stronger positive bias in the years prior to 1956 than in the following years. The removal of the size limit should also have decreased the negative bias in estimates of the relative contribution of ages 2 and 3 to the overall age distribution of the population.

Some of the changes listed in Table 3 are different ways of looking at the same phenomenon. For example, the decrease in guiding,

Table 3. Changes in Lake Opeongo creel survey procedures and their effects on potential applications of creel survey data. Most changes led to a change in coverage. The table identifies consequences of failing to correct for such changes. The effects most important at Lake Opeongo are asterisked. LT = lake trout.

	Application of data			
Change in survey procedure	Estimating relative abundance with reported catch-per-unit-effort (CUE) data	Estimating total catch[3]	Estimating total fishing effort[3]	Characterizing size and age of fish at large with sampled fish
Decrease in number of hours that survey hut is staffed	No effect	*Decrease in coverage; catch underestimated, both species	*Underestimate effort for both species	No effect
Increase in proportion of weekday coverage to total coverage[1,2]	CUE underestimates LT abundance (campers are poor LT fishermen)	*Probable increase in coverage; catch overestimated for both species	Overestimate effort for both species	No effect
Increased survey of campers[1]	CUE underestimates LT abundance	Probable increase in coverage; catch overestimated for both species	Overestimate effort for both species	No effect
Survey form does not ask for number of anglers	CUE less reliable; overestimates abundance	No effect	Effort values less reliable; underestimate effort	No effect
Outfitter less inclined to advise lab of angler returning from fishing	No effect if outfitter ignores anglers both with and without catch	Underestimate catch for both species	Underestimate effort for both species	No effect
Tendency of outfitter to only advise lab of parties with catch	*CUE overestimates abundance for both species	No effect	*Underestimate effort for both species	No effect

[1]Only one direction of change is listed, but change in both directions has occurred over duration of creel survey at Lake Opeongo.
[2]i.e. more campers surveyed.
[3]Assumes percent coverage has been estimated before change occurs and no correction is made after change occurs.

Table 4. Changes in Lake Opeongo angler characteristics and their effects on potential applications of creel survey data. Most changes led to a change in overall angler effectiveness. The table identifies consequences of failing to correct for such changes. The effects most important at Lake Opeongo are asterisked. LT = lake trout, SMB = smallmouth bass.

	Application of data			
Change in angler characteristics	Estimating relative abundance with reported catch-per-unit-effort (CUE) data	Estimating total catch	Estimating total fishing effort	Characterizing size and age of fish at large with sampled fish
Increased gear efficiency (depth sounder, spinning gear, etc.)	CUE overestimates abundance for both species	No effect	Unit of effort represents more actual effort than before	No effect
Decrease in number of guided parties	*CUE underestimates abundance for LT particularly	*Underestimate catch, for LT particularly (guided parties always reported to lab)	*Unit of effort represents less actual effort than before; LT affected particularly	No effect
Increase in skill of local anglers	CUE overestimates abundance for LT particularly	No effect	Unit of effort represents more actual effort than before; LT affected particularly	No effect
Increase in number of novice anglers	CUE underestimates abundance for both species	Little effect	*Unit of effort represents less actual effort than before; both species affected	No effect
Increase in number of campers	CUE underestimates abundance for LT particularly (campers are not skilled LT anglers)	*Campers less well surveyed; therefore underestimate catch for SMB particularly	*Underestimate effort for both species; LT bias is offset by low effectiveness of campers	No effect
Accommodations no longer available at lodge; anglers dispersed	Same as increase in camping	Same as increase in camping	Same as increase in camping	No effect
World War II: decrease in number of anglers, all of which use outfitter	No effect	*Anglers more easily surveyed; overestimate catch for both species	*Overestimate effort for both species	No effect
Temporal pattern of angling more unpredictable	No effect	Underestimate catch, SMB particularly affected	Underestimate effort, SMB particularly affected	No effect
Removal of SMB minimum size limit	No effect	No effect	No effect	Smaller SMB kept. Better representation of mean size of young SMB

increase in camping, closing of accommodations for anglers at Avery's lodge, and the increased irregularity in the temporal pattern of angling, all reflect the increasing tendency for parties to spend a holiday on Lake Opeongo based on activities other than angling. The net effect of this phenomenon may, therefore, be less than the sum of all of the individual effects shown in Table 3.

Table 5. Length frequency distribution of lake trout marked on the lake, and percent recovered onshore by size classes in cm. "Total marked" excludes some fish for which length data were judged to be in error (from Regier 1971).

Length class	Total marked	% recovered
10.0-19.9	2	0
20.0-29.9	17	41
30.0-39.9	103	33
40.0-49.9	155	42
50.0-59.9	78	46
60.0-69.9	47	51
70.0-79.9	15	40
80.0-89.9	3	0

Fig. 7 summarizes the time periods over which changes affecting Lake Opeongo creel survey data occurred. The order of changes has been kept the same as in Table 3, but the less significant changes have been omitted. The period prior to the mid-1950s is least affected by change. A number of concurrent changes began to have a noticeable impact on the creel survey in the mid-1950s. The most significant of these (decrease in number of guided parties, increase in camping on lake) had stopped by the 1970s, and there is another relatively stable period in the survey data during this decade. The rapid increase in the number of novice anglers, observed in the 1980s, may have again changed overall angler efficiency considerably.

Some additional factors may influence interpretation of creel survey data. Since aging by scale annuli is subject to individual interpretation, the entire series of scales should be read by one person for best consistency. This has been done recently for both lake trout and smallmouth bass from Lake Opeongo, but published papers, before 1981 for lake trout and before 1974 for smallmouth bass, present ages provided by more than one person.

Lake trout and smallmouth bass are thought, by those who have been closely associated with

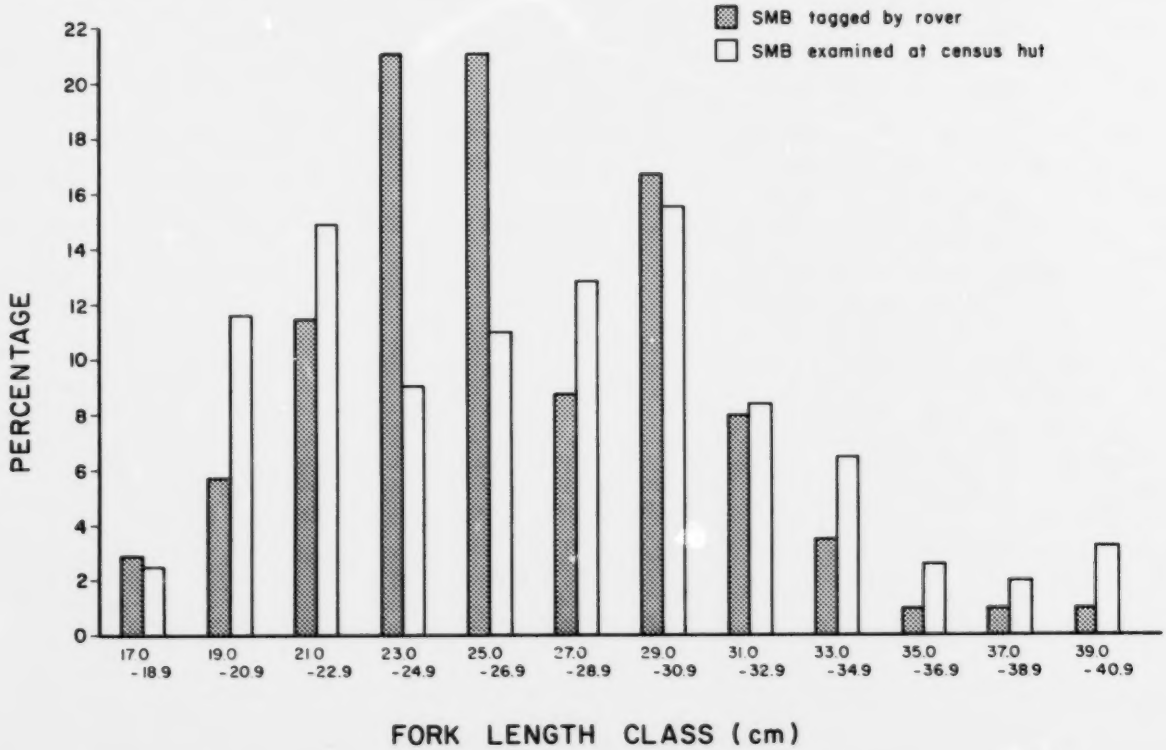

Figure 6. A comparison of the fork-length frequencies of: (1) angler-caught smallmouth bass examined on the lake by a roving interviewer, and (2) angler-caught smallmouth bass examined at the creel survey hut. Data from the period July 25-Aug. 7, 1970.

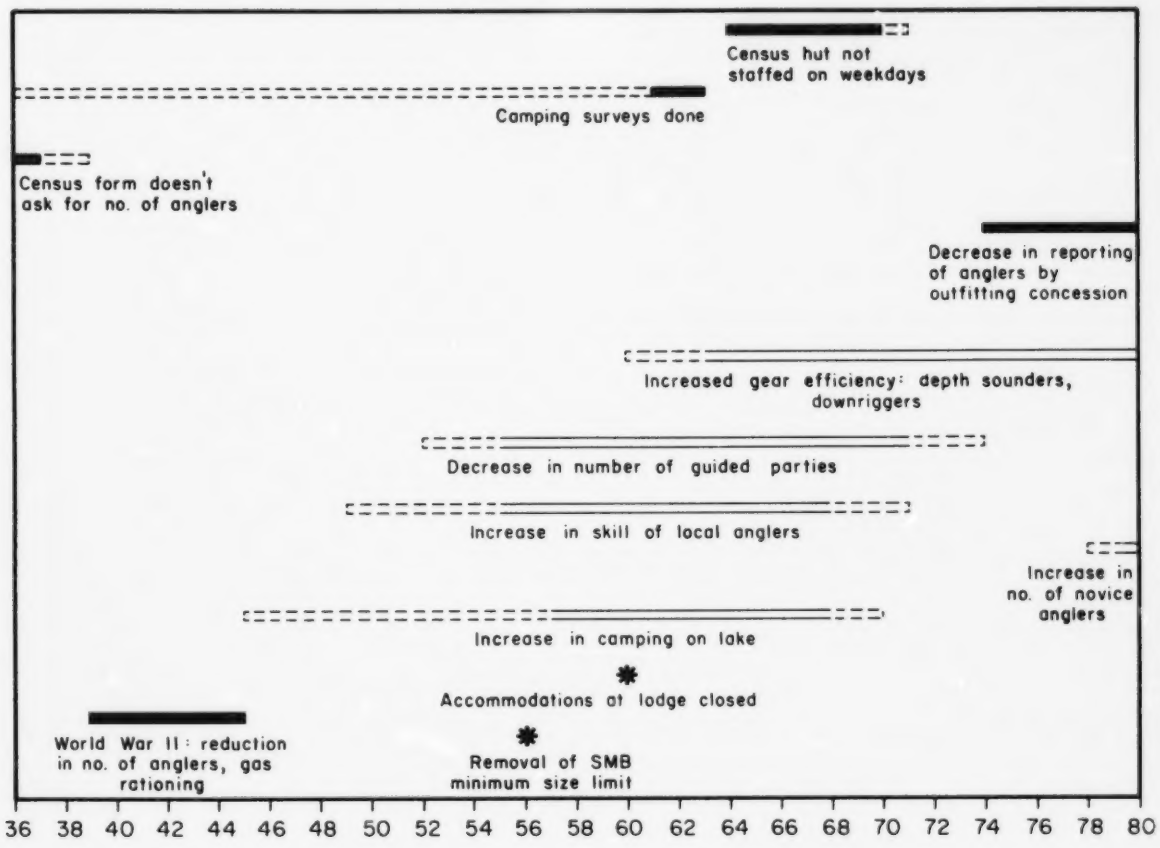
Census hut not staffed on weekdays
Camping surveys done
Census form doesn't ask for no. of anglers
Decrease in reporting of anglers by outfitting concession
Increased gear efficiency: depth sounders, downriggers
Decrease in number of guided parties
Increase in skill of local anglers
Increase in no. of novice anglers
Increase in camping on lake
Accommodations at lodge closed
World War II: reduction in no. of anglers, gas rationing
Removal of SMB minimum size limit
36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80
YEAR

Figure 7. Duration of changes affecting Lake Opeongo creel survey data. Shaded bars identify those changes which had a constant effect on the character of creel survey data; open bars identify those changes whose effects either increased or decreased throughout the period indicated. Dashed bars are used to indicate situations where the start or end of a change cannot be precisely dated.

the creel survey, to differ in their ability to survive upon release by anglers. Lake trout are unlikely to survive, as they are usually brought up quickly from a considerable depth. Smallmouth bass have a good chance of surviving unless they are deeply hooked. Fraser (pers. comm.) estimates that one-third of bass caught are deeply hooked. Many of these fish, however, would not be released by anglers. Total fishing mortality for lake trout is therefore best approximated by the number of fish caught, while total fishing mortality for smallmouth bass is best approximated by the number of fish kept.

The accuracy of reports by anglers of the number of fish kept, the number of fish caught, and the number of hours spent fishing probably varies with the species of fish, the number of days spent fishing, and the actual number of fish caught. In general, the capture of a lake trout is a rarer and more memorable event than the capture of a smallmouth bass. If a party has camped on the lake for several days, its members may not remember the exact number of fish caught or the hours spent fishing. Also, when a very large number of fish are caught (usually bass), anglers tend to report the number in round figures. Anglers have no strong reason to knowingly give false information to survey staff about the number of fish caught or the number of hours spent fishing, and are thought to reply honestly. They will, however, lie about where they caught the fish, if they think that survey staff might inform other anglers (J.A. MacLean, pers. comm.).

Fig. 8 presents "optimistic" and "pessimistic" estimates of the survey coverage for smallmouth bass from 1936 to 1980. We define coverage as the fraction of the total number of smallmouth bass kept by anglers that is recorded by the survey. The optimistic estimate, or upper bound, is based on the opinions of those closely associated with the survey and on written reports. The pessimistic estimate, or lower bound, is based on the mark-recapture studies of H.A. Regier (unpubl. data) and A.R. Emery (unpubl. data) and on the probable impact of known changes in the fishery. Coverage estimates, based on mark-recapture studies, are labelled as pessimistic because known difficulties in identifying marked fish at the survey station may have introduced a significant negative bias into the estimation procedure (D. Cucin, pers. comm.).

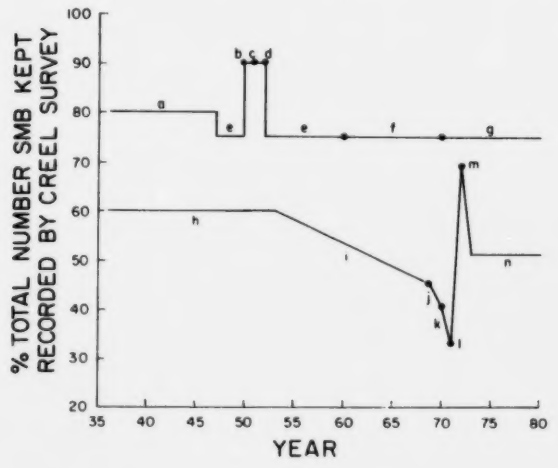

Figure 8. Upper and lower bounds for coverage of the smallmouth bass catch by the Lake Opeongo creel survey. Coverage for a year is: the fraction, of the total number of smallmouth bass kept by anglers, that was recorded by the creel survey. Letters marking a segment of, or a point on, the upper and lower boundary lines correspond with the sources listed below. a - Fry 1949. b - Baldwin 1951. c - Martin 1952. d - Martin 1953. e - Martin (pers. comm.). f - Fraser (pers. comm.). g - Cucin (pers. comm.). h - Most survey personnel estimate coverage for this period at 80%; we judged that a lower limit on coverage could not be less than 60%. i - Coverage likely deteriorated with the increase in camping and decrease in guiding that began to have a noticeable impact in the mid-1950s (Martin pers. comm.). j,k - Estimates derived from analysis of H.A. Regier's unpubl. data. l,m - A.R. Emery (unpubl. data). n - Continuation of the 1971-72 average to the present.

A similar approach might be taken to estimate total effort expended to catch lake trout. It is important to note, however, that the survey is less effective in sampling effort than it is in sampling catch. Anglers leaving the lake without a catch, at a time when the survey station is unoccupied, are not likely to contact the laboratory on their own initiative, and the outfitters are also not likely to notify the laboratory.

Survey personnel interviewed thought that lake trout coverage was always higher than smallmouth bass coverage, but were unable to express this difference quantitatively. The only empirical study of the question (Regier 1971) suggested that lake trout coverage in 1969 was relatively low (~40%). If it were possible to obtain accurate estimates of coverage for both species over the entire survey period, the majority of workers interviewed felt that: (1) the lake trout curve would closely follow the upper bound in Fig. 8, particularly in the early years of the survey; (2) the lake trout curve would lie above the smallmouth bass curve throughout the survey period; and (3) the distance between the two curves would be substantially greater in more recent years.

Our purpose has not been to provide the "correct" coverage value for either smallmouth bass or lake trout. Rather, we have tried to emphasize the discrepancy between informal assessments by biologists (with extensive experience of the survey) and the results of empirical studies (Regier 1971; Regier and Emery, unpubl. data). The material reviewed for this report does not contain sufficient information to permit a resolution of this disagreement. A resolution would be of value, since the absence of reliable coverage estimates places significant limitations on the usefulness of the creel survey data.

SUMMARY

This report has consisted of three main sections: first, a description of changes in Lake Opeongo creel survey procedures; second, a description of changes in the characteristics of Lake Opeongo anglers; and third, a consideration of how these changes affect interpretation of survey data. The two most significant changes have been a decrease in the number of guided parties, and an increase in the amount of camping on undeveloped sites around the lake.

The effects that these and other changes have had on angler efficiency and survey coverage are complicated. For example, the decrease in guiding, beginning in the mid-1950s, caused a

reduction in angler efficiency, but there were partially compensatory increases in gear efficiency and the skill of local anglers. The net effect on angler efficiency is uncertain. Many factors have contributed to a decline in survey coverage: changes in survey procedures, the decrease in guiding, increase in camping, change in the operator of the outfitting concession, and the closure of accommodation for anglers provided by the outfitter. An improved weekday survey, during the 1970s, partially countered this decline.

The reader is encouraged to consult Tables 3 and 4 for a synopsis of the problems involved in using creel survey data to estimate relative abundance, total catch, and total fishing effort, and to represent the size and age of fish in a population. Survey data are most consistent from 1936 to the mid-1950s, and during the decade of the 1970s. Upper and lower bounds have been set on the percentage of the total catch covered by the creel survey.

ACKNOWLEDGEMENTS

We thank D. Cucin, J.M. Fraser, F.E.J. Fry, J.A. MacLean, N.V. Martin and R.J. Murdock for their cooperation. We also thank H.A. Regier for allowing us access to his unpublished data. The 1969 and 1970 studies of creel survey coverage were funded through a grant to H.A. Regier at the University of Toronto. M. Hirst typed the manuscript and G. Szram prepared the figures.

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APPENDIX

APPENDIX A. REGULATIONS ON THE SMALLMOUTH BASS (SMB) AND LAKE TROUT (LT) FISHERIES IN LAKE OPEONGO, 1936-1982.

Seasons

SMB			LT	
Years	Opening date	Closing date	Years	No fishing allowed
1936-57	June 30	Oct. 16	1936-48	Oct. 15 thru Nov. 15
1958	June 27	Oct. 16	1949-54	Oct. 6 thru Nov. 5
1959	June 30	Oct. 16	1955-56	Oct. 16 thru next Apr. 30 (or Fri.
1960-62	July 1	Oct. 15		immediately preceeding Apr. 30 when
1963-64	July 1	Nov. 30		it falls on a Sat., Sun., or Mon.)
1965	June 26	Nov. 30	1967-69	Oct. 16 thru Fri. preceeding last
1966	June 25	Nov. 30		Sat. in April
1967	last Sat. in June	Nov. 30	1970-82	Oct. 11 thru Fri. preceeding last Sat. in April
1968-69	last Sat. in June	Oct. 15		
1970-81	last Sat. in June	Nov. 30		

Daily catch and possession limits

SMB			LT		
Year	Catch	Possession	Year	Catch	Possession
1936-53	6	12	1936-53	5	10
1954-81	6	6	1954-59	5	5
			1960-64	3	3
			1965	5	5
			1966	3	3
			1967	5	5
			1968-1981	3	3

Minimum size limit

SMB		LT	
Years	Limit	Years	Limit
1936-53	10 inch fork length	1936-81	no limit
1954-55	11 inch total length		
1956-81	no limit		

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